REMARKS

Introductory Comments:

Claims 1-20 are pending in the application. The Applicants respectfully request reconsideration of claims 1-20.

In Response To The Specification Objections:

The Applicants have attached a Marked-Up Version and Clean Version of the application attached herewith, which includes an amended page including the Abstract such that the Abstract is now properly on a separate page, further, page numbers are now properly included in accordance with the Examiner's suggestion. No new matter has bcen added.

In Response To The Claim Rejections:

Claims 1-10 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,471,214 (Faibish et al.) in view of U.S. Patent 5,134,371 (Watanabe et al.). Claims 11-18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Faibish et al. in view of Watanabe et al. and further in view of U.S. Patent 5,767,766 (Kwun et al.).

According to the Office Action, Faibish et al. discloses the claimed warning system for a vehicle and provides electro magnetic sensors for providing collision alert signals. The Office Action recognizes that Faibish fails to provide magneto-resistive sensors. However, the Office Action alleges that Watanabe shows determining the proximity of objects through employing magneto rcsistive sensors MRE's, col. 2, lines 15-61.

The Applicants submit that it would not have been obvious to combine the Faibish and Watanabe references to arrive at the present invention. No reason is shown why one of ordinary skill in the art would modify the Faibish and Watanabe, references as the Office Action proposes. The references are not pertinent to the problem of determining the magnitude and direction of magnetic field variation in a near vehicle sensor area, as claimed by the Applicants, for the purpose of vehicle blind-spot warnings. Applicants' design is unique in that it includes vehicle detection through passive sensors not requiring power for system activation, as discussed in paragraph [0032]. Further, Applicants' design allows for real-time threat or lane availability analysis, which allows for reaction to crash or lane change events milliseconds before a radar-based system, such as the one used in Faibish, would.

The Faibish reference is directed to a vehicle using an electromagnetic radar transmitter and receiver apparatus for pre-crash situations. (Column 5, Lines 4-7.) More importantly, however, Faibish does not disclose or teach a magneto-resistive sensor or use of magnetic fields for sensing objects, as recited in claims 1, and 19. Instead, the Faibish system is conventional in that it includes a radar-type sensor. Faibish does not disclose or suggest that the sensor uses magnetic fields for pre-crash sensing, as is recited in claims 1-20. The magneto-resistive sensor is defined such that it makes "use of magnetic field changes that occur when metallic compounds, such as target vehicles, pass within close proximity of [its] respective permanent magnets." (Paragraph [0032].) Faibish does not disclose or suggest an embodiment including use of magnetic fields for detecting metallic structures.

Radar sensors have limitations including that they merely detect any objects, whereby signals therefrom require processing for analyzing what type of object is detected. Therefore, systems like Faibish require further processing of sensor signals for object recognition and/or require additional sensors, such as laser sensors, for verifying that the object is a vehicle in a blind spot or on a potential collision course with the host vehicle. Problems inherent in the Faibish design, including device sensitivity limitations, are solved therein using lasers to determine or verify "real danger" conditions. (e.g. Column 9, lines 49-63.) These verification systems are less efficient, both due to power consumption and component costs, than the magneto-resistive sensor design of claims 1 and 19.

Further, the Faibish design is merely tailored for a general pre-crash or crash avoidance system. In contrast, the present invention is tailored to a blind-spot analysis not detecting all objects near a vehicle but rather detecting only *vehicles* in blind spots, as the claimed sensors are optimal for detecting metallic objects.

The Watanabe reference is directed to a conventional pulse signal detection means. Watanabe, however, does not disclose or teach the use of magneto-resistive sensors or generation of magnetic signals in areas near rear of a vehicle as recited in the claims. Watanabe also does not teach or suggest that application of the Watanabe system would be in any way beneficial to blind-spot assessment systems as is the claimed system. Instead, Watanabe merely teaches use of magnets for sensing rotational speed of, for example, a wheel of an automobile. (e.g. Column 16, Lines 21-64.) It would not, therefore, have been obvious to modify Watanabe as the Office Action proposes.

The Faibish reference is directed to a conventional collision avoidance system and the Watanabe reference is directed to a conventional magnetic detection device. More importantly, neither of these references discloses or teaches a magneto-resistive sensor coupled to a vehicle for detecting an approaching metallic vehicle or a metallic vehicle in a blind spot as recited in the claims. Further, no reason has been shown why it would be obvious to selectively combine these references to produce the claimed invention. Applicants therefore submit that no motivation has been shown to combine the references as proposed.

"Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination." ACS Hospital Systems, Inc. v. Montefiore Hospital, 732 F.2d 1672, 1577, 221 USPQ 929, 933 (Fed.Cir. 1984). Even if all the elements of the Applicants' invention are disclosed in various prior art references, the claimed invention taken as a whole cannot be said to be obvious without some reason given in the prior art why one of ordinary skill would have been prompted to combine the teachings of the references to arrive at the claimed invention. Therefore, because no teaching or suggestion is found in any of the references for magneto-resistive sensors used in a blind-spot detection system, claims 1 and 19 are believed to be allowable.

The unique use of the magneto-resistive sensors for determining whether a vehicle is in a blind-spot, as claimed by the Applicants, is advantageous in that it eliminates need for processing steps required by non-magneto-resistive sensors for determining the nature of the "object" in the blind-spot, such as those occurring when a non-metallic object is approaching a vehicle or the vehicle is approaching a non-

metallic object. Whereas, radar-based designs, such as the ones used in Faibish, are subject to further processing requirements in addition to requiring radar sensors, which tend to be costlier and tend to consume valuable power resources. Watanabe, on the other hand discloses sensors including magnetic elements but does not teach or suggest blind-spot analysis using those sensors. Watanabe merely suggests that these sensors may be applicable to detecting a rotational speed of a wheel of an automobile with ABS. No reason is provided why altering the Watanabe or Faibish designs for use in a blind-spot warning system would be in any way beneficial.

Claims 1 and 19 are believed to be allowable for at least the aforementioned reasons. Claims 2-10 and 20 depend from claims 1 and 19 and are also believed to be allowable for at least the aforementioned reasons.

Regarding the rejections of claims 7 and 19, the Applicants believe claims 7 and 19 are allowable for the aforementioned reasons and because the claims and the prior art differ. Both claims 7 and 19 require the sensors coupled to a rear area of the host vehicle. Neither Faibish nor Watanabe disclose or suggest including sensors in the rear of the vehicle. Instead, Faibish includes radar and laser sensors in the front of the vehicle, as illustrated 3A-8C, and Watanabe does not disclose coupling sensors to any part of a vehicle other than in relation to a wheel. (e.g. column 5, lines 53-55.) In contrast, the Applicants include the magneto-resistive sensors coupled to the rear of the vehicle so that they are positioned for detecting changes in a magnetic flux in blind-spots of the vehicle. Neither Faibish nor Watanabe are suited for this purpose as they lack the appropriate positioning of remote sensors. Therefore, claims 7 and 19 are believed to be allowable because the claims and the prior art differ.

Regarding the rejection of claim 16, the Applicants believe claim 16 is allowable for the aforementioned reasons and because the claims and the prior art differ. Claim 16 requires processing a temporal and signal strength correlation algorithm for analyzing the magnetic field signature for determining a size of the target vehicle. Neither Faibish nor Watanabe disclose or suggest determining a size of the target vehicle. Vehicle size determinations, which are made possible through magnetic field analysis, in accordance with the present invention, allow for further analysis blind-spot data such that countermeasures or warnings that may be activated for a larger vehicle would not be activated for a smaller vehicle. Further, this size determination is generated directly as a result of changes in the magnetic field and would not, as would Faibish or Watanabe, require substantial vehicle recognition software or analysis. Therefore, claim 16 is believed to be allowable because the claims and the prior art differ.

As mentioned, claims 11-18 and 20 are rejected over Faibish and Watanabe as applied to claims 1 and 19 above, and further in view of Kwun. The Office Action alleges that Faibish and Watanabe teach the system of claims 11-18 and 20 while recognizing it lacks teaching for the countermeasures included therein. However, according to the Office Action, Kwun shows the specific use of activating countermeasures 68-74 in figure 3.

The Applicants believe claims 11-18 are allowable because the claims and the prior art differ. Claims 11-18 require sensing magnetic field changes caused by a target object in or near *a vehicle blind-spot*. Faibish, Watanabe, and Kwun do not disclose or suggest including sensors for detecting vehicle blind-spot information.

Instead, Faibish includes radar and laser sensors in the front of the vehicle, as illustrated 3A-8C, Watanabe does not disclose coupling sensors to any part of a vehicle other than in relation to a wheel (e.g. column 5, lines 53-55), and Kwun does not include remote sensors at all. Applicants include the magneto-resistive sensors coupled to the rear of the vehicle so that they are positioned for detecting changes in a magnetic flux in blind-spots of the vehicle. None of Faibish, Watanabe, or Kwun are suited for this purpose as they lack the appropriate positioning of remote sensors and detection of magnetic flux changes in the blind-spots. Therefore, claims 11-18 are believed to be allowable because the claims and the prior art differ.

Further, as discussed above regarding claims 1-10 and 19, no teaching or suggestion is provided for the combination of Faibish and Watanabe, and for at least this reason, claims 11-18 and 20 are believed to be allowable. Further, no teaching or suggestion is found for combining Kwun with the aforementioned references to arrive at the present invention. Kwun is directed to an impact or post-impact countermeasure activation system. More importantly, nothing in Kwun indicates it would be applicable to pre-crash or lane-change threat assessment. Rather, Kwun teaches away from such a combination as it incorporates sensors detecting stress waves in vehicle structure generated in response to impact. (See Abstract.) In contrast, the present invention requires remote and passive detection of variations in magnetic waves in areas generally close to the vehicle for blind-spot warning situations, all of which occur prior to impact. Further, nothing in Faibish or Watanabe teach or suggest that a post-impact system and countermeasures therefor would be beneficial to a blind-spot warning system.

It is therefore believed that claims 11-18 and 20 are allowable because no teaching or suggestion is provided in the prior art for the alleged combination and because Kwun teaches away from such a combination.

In view of the aforementioned remarks, it is respectfully submitted that all pending claims are in a condition for allowance. A notice of allowability is therefore respectfully solicited. Please charge any fees required in the filing of this amendment to Deposit Account 06-1510 or if insufficient funds use 06-1505.

The Examiner is invited to contact the undersigned at (248) 223-9500 if any unresolved matters remain.

Respectfully Submitted,

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~~SPECIFICATION~~

Electronic Version 1.2.8
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Blind-Spot Warning System For An Automotive Vehicle

Cross Reference to Related Applications

The present invention claims priority to provisional application no. 60/476,521 filed on June 6, 2003.

Background of Invention

[0001] Collision warning systems are becoming more widely used. In general, collision warning systems provide a vehicle operator knowledge and awareness of objects or vehicles within close proximity so as to prevent a collision with those objects. Current collision warning systems are unitary in nature in that they only warn the operator of the vehicle containing the collision warning system of a potential collision. A sensor located on a vehicle, upon sensing an object generates an object detection signal, which is communicated to the operator of that vehicle.

[0002] Warning systems for vehicles that are directed to the rear of the vehicle are known. However, high end warning systems require expensive sensors and sensing equipment. Conversely, most inexpensive systems cannot provide the required performance across all ranges of environment conditions and target types. Also, rear-sensing systems tend to monitor the rear of the vehicle without monitoring the transition of a vehicle from the rear of the vehicle to the blind-spot.

[0003] Therefore, it would be desirable to provide an improved blind-spot warning system. The improved system may increase reaction time and decrease the probability of a collision occurring while reducing costs associated with the system.

Summary of Invention

[0004] In one aspect of the invention, a host vehicle system includes a blind-spot

warning system providing an indication to the host vehicle of a target vehicle entering a blind-spot. The system includes a vehicle bus receiving various vehicle control signals, magneto-resistive sensors receiving proximity information as a function of magnetic field variations, a smart algorithm controller analyzing bus signals and sensor signals, and various vehicle collision systems such as passive restraints, optical light guides, and audible warnings operating in response to a threat from a target vehicle.

[0005] In a further aspect of the invention, a method for operating a blind-spot detection system for a host vehicle includes sensing magnetic field changes caused by a target object in or near a vehicle blind-spot. A magnetic field signature is generated as a function of the magnetic field changes. At least one algorithm is processed as a function of the magnetic field signature, and a countermeasure is activated in response to signals indicating a target vehicle in or near the vehicle blind-spot as a function of the processing of the algorithm.

[0006] Accordingly, an advantage of the present invention is to provide an improved blind-spot warning system for use in an automotive vehicle.

[0007] Advantages over optical and hall sensor techniques are numerous in that these sensors are inexpensive, are well suited for variable temperatures and rugged environments, and offer excellent response and significantly less need for readjustment when the system is jostled or vibrating.

[0008] Another advantage of the present invention is that it increases the reaction time for both operators of the target vehicle and the approaching vehicle. Thereby, decreasing the probability of a collision between the two vehicles.

[0009] Other advantages and features of the present invention will become apparent when viewed in light of the detailed description of the preferred embodiment when taken in conjunction with the attached drawings and appended claims.

Brief Description of Drawings

[0010] Figure 1 is a top diagrammatic view of a host vehicle in accordance with one embodiment of the present invention;

[0011] Figure 2 is a system diagram of the host vehicle of Figure 1;

[0012] Figure 3A is a top view of a magneto-resistive sensor in accordance with another embodiment of the present invention;

[0013] Figure 3B is a side view of Figure 3A;

[0014] Figure 4A is a graph of magneto-resistive sensor properties of a sensor in a westward direction, perpendicular to a direction of travel of a target vehicle;

[0015] Figure 4B is a graph of magneto-resistive sensor properties of the sensor of Figure 4A in a southward direction, opposing a direction of travel of the target vehicle;

[0016] Figure 4C is a graph of magneto-resistive sensor properties of the sensor of Figure 4A in an upwards direction, perpendicular to the earth over which the target vehicle is passing;

[0017] Figure 4D is a graph of magneto-resistive sensor properties of the sensor of Figure 4A wherein a magnitude of the target vehicle is illustrated; and

[0018] Figure 5 is a flow chart of the operation of the blind-spot warning system.

Detailed Description

[0019] In the following figures the same reference numerals will be used to illustrate the same components. While the present invention is described with respect to a particular method and apparatus for blind-spot warning, various adaptations will be evident to those skilled in the art.

[0020] Referring now to Figures 1 and 2, a host vehicle system 10 having a blind-spot warning system 12, in accordance with one embodiment of the present invention, is illustrated. Representations of blind-spots 14, 15 are illustrated. The blind-spots 14, 15 are the areas beyond which the external rear-view mirrors 17, 19 cannot see without requiring the driver to glance back. The blind-spots 14, 15 may be of many shapes and sizes depending on various factors such as mirror size and vehicle configuration.

[0021]

The blind-spot warning system 12 provides an indication to the host vehicle driver

as to the entering of a target vehicle within at least one of the blind-spots 14, 15. The system 12 includes a vehicle bus 39 receiving various vehicle control signals 32, magneto-resistive sensors 16, 18 receiving proximity information 34, a smart algorithm controller 36 (digital signal processor and smart algorithms), a vehicle warning interface 38, and various vehicle collision systems such as passive restraints 40, optical light guides 42, and audible warnings 44. All of these devices will be discussed later.

[0022] The host vehicle 10 includes two magneto-resistive sensors 16, 18 having respective fields of view 20, 22. The fields of view 20, 22 may not overlap or may slightly overlap blind-spots 14, 15. Therefore, the present invention also monitors the transition from the sensor fields of view 20, 22 to the blind-spots 14, 15. Sensors 16, 18 are preferably magneto-resistive sensors.

[0023] Today''s technology allows small sensors to be placed inconspicuously on rear panels 30, 32 of the vehicle so as not to become aesthetically displeasing. Various locations near the rear of the vehicle 10 including the trunk lid 60, the tailgate 62, the bumper 64, an area above the tires 66, 68, an area within vehicle side panels 30, 32, or a rear portion of the roof 70 may all be desirable locations for the sensors 16, 18.

[0024] The sensors 16, 18, sense target objects or vehicles. A target vehicle is any vehicle proceeding from directly behind host vehicle 10 to approaching the host vehicle 10 on the passenger side and eventually entering into one of the blind-spots 14, 15.

[0025] Referring now to Figure 2, a block diagram of the blind-spot warning system 12 or Next Generation Blind-spot Detection System (NG-BDS) is illustrated. As was mentioned, the system 12 includes the magneto-resistive sensors 16, 18 receiving proximity information 34; the vehicle bus 39 receiving various vehicle control signals 32; the smart algorithm controller 36 processing signals from the vehicle bus 39 and the magneto-resistive sensors 16, 18; the vehicle warning interface 38 responding to controller signals; and various vehicle collision systems activated in response to signals from the vehicle warning interface 38.

[0026]

The magneto-resistive sensors 16, 18, which are illustrated in Figures 3A and 3B, receive proximity information 34 from areas 20, 22. A top view of a sensor 16 or 18 is

illustrated in Figure 3A, and a side view of the sensor 16 or 18 is illustrated in Figure 3B. Both sensors 16, 18 are embodied as passive such that no power is required in order to activate the system 12, however, signals received from the sensors 16, 18 are in the form of changes in current as a function of magnetic field changes. The magneto-resistive sensors 16, 18 make use of magnetic field changes that occur when metallic compounds, such as target vehicles, pass within close proximity of their respective permanent magnets. The field changes are received in the controller 36 to determine the properties of the target vehicle"s motion. These small sensors 16, 18 are effective in observing linear as well as circular motion.

[0027] The magneto-resistive sensors 16, 18 are mounted in the rear quarter panels 30, 32 of the vehicle 10 as displayed in Figure 1. The sensors 16, 18 can determine the magnitude and direction of magnetic field variation within a range of, for example, 15 meters. These sensors 16, 18 have sufficient sensitivity to measure variations in the Earth"s magnetic field to, for example, 1 part in 12000. Once a sufficient magnetic field variation is observed and is correlated to the vehicle"s dynamics in the controller 36, a suitable countermeasure is determined and implemented.

[0028] The first magneto-resistive sensor 16 senses a first magnetic field variation in a first sensor area 20, and the second magneto-resistive sensor 18 senses a second magnetic field variation in a second sensor area 22. In other words, in response to target vehicles entering one or both of the sensor areas 20, 22, signals are generated through the respective sensors 16, 18 as a function of magnetic field variation.

[0029] The smart algorithm controller 36 or Digital Signal Processor (DSP), including logic further illustrated in Figure 5, implements advanced algorithms for processing signals from the vehicle bus 39 and the magneto-resistive sensors 16, 18. These advanced algorithms, also referred to as smart algorithms, include, for example, a magnetic signal conditioning algorithm including filtering and smoothing algorithms, a temporal and signal strength correlation algorithm, a vehicle state definition algorithm, and a countermeasure state definition algorithm.

[0030] The controller 36 is preferably a microprocessor-based controller having a central processing unit, internal memory such as RAM or ROM, and associated inputs and outputs communicating across the 39 bus. The controller 36 may be a portion of a

central vehicle main control unit or stand-alone unit. The controller 36 may include various processing units which may be incorporated as separate devices or as an integral part of the controller.

[0031] The controller 36 receives information from the magneto-resistive sensor (MRS) and vehicle status data from the vehicle gateway bus. In real-time, the advanced algorithms determine the likelihood of a threat on the roadway. Once the severity of a threat has been determined, the controller 36 communicates through the vehicle interface unit 38 that can result in optical, audible, or voice warnings, including the use of a passive restraint system 40.

[0032] The vehicle interface unit 38 or vehicle warning interface receives signals from the controller 36 and activates vehicle systems including, for example, optical warnings from dashboard lights 74 or light guides 42 or a light emitting diode (LED), audible warnings from the radio 44 or a speaker, visual warnings from a heads-up display, or voice warnings from a pre-crash warning system 76. The embodied interface unit 38 also activates the passive restraint system 40 when a threat in the blind-spot is determined by the controller 36.

[0033] The vehicle bus 39 receives various vehicle control signals 32 and generates therefrom vehicle status data. Sensors and control units generating vehicle control signals include, for example, a vehicle type information unit 77 generating vehicle type information, vehicle speed sensors 78 generating vehicle speed signals, an RPM (revolutions per minute) reader 80 generating RPM signals, a heading indicator 82 generating a heading of host vehicle signal, a location indicator 84 such as a GPS system generating a location of vehicle signal, a directional signal generator 86 generating a host vehicle directional signal (e.g. left, right, heading), a steering wheel angle sensor 88 generating a steering wheel angle signal, and a brake status sensor 90 generating a brake status signal. One skilled in the art will realize that the vehicle bus 39 may also receive various other sensor and control signals.

[0034] Referring now to Figures 4A-4D, experimental results of magneto-resistive sensors sensing a target vehicle passing a host vehicle are illustrated. As illustrated, the magneto-resistive sensors 16, 18 can easily determine the presence of the target vehicle in a host vehicle blind-spot and detect the relative motion of the vehicles,

which may be used in threat detection algorithms. Figure 4A is a graph of magneto-resistive sensor properties of a sensor is in a westward direction, perpendicular to a direction of travel of a passing vehicle. Figure 4B is a graph of magneto-resistive sensor properties of the sensor of Figure 4A in a southward direction, opposing a direction of travel of the passing vehicle. Figure 4C is a graph of magneto-resistive sensor properties of the sensor of Figure 4A in an upwards direction, perpendicular to the earth over which the vehicle is passing. Figure 4D is a graph of magneto-resistive sensor properties of the sensor of Figure 4A wherein a magnitude of the passing vehicle is illustrated.

[0035] Referring to Figure 5, a flow chart 100 of the operation of the blind-spot warning system, in accordance with another embodiment of the present invention, is illustrated. Logic starts in operation block 102 when a target vehicle or object is sensed in the sensor 16 or 18.

[0036] In operation block 104, the vehicle gateway bus 39 receives vehicle control signals 32 and generates therefrom a vehicle bus signals.

[0037] In operation block 106, the controller 36 or digital signal processor receives the change of current or magnetic field signature from the sensor 16 or 18 and the vehicle bus signals and activates various algorithms to process the signals.

[0038] In operation block 108, a magnetic signal conditioning algorithm is activated; and the magnetic field signature is filtered and smoothed.

[0039] In operation block 110, a temporal and signal strength correlation algorithm is activated; and the magnetic field signature is analyzed to determine the proximity and size of the target vehicle.

[0040] In operation block 112, a vehicle state definition algorithm is activated; and the state of the host vehicle in relation to the target vehicle is determined.

[0041] In operation block 114, a countermeasure state definition algorithm is activated; and a determination is made whether a countermeasure is required and also which countermeasure may be required.

[0042] In operation block 116, countermeasures are activated in response to signals from

operation block 114 indicating a target vehicle in or near a blind-spot 14 or 15 of the host vehicle 10.

[0043] This technology is relatively low cost and holds the potential to be implemented with high operating performance.

[0044] In operation, a method for operating a blind-spot detection system for a host vehicle includes sensing magnetic field changes caused by a target object in or near a vehicle blind-spot; and generating a magnetic field signature as a function of the magnetic field changes. The method also includes receiving a vehicle control signal from a vehicle system and generating a vehicle bus signal from the vehicle control signal.

[0045] The method still further includes processing an algorithm as a function of the vehicle bus signal and the magnetic field signature. This processing may include determining required countermeasures necessary to reduce a likelihood of an accident, processing a magnetic signal conditioning algorithm for filtering and smoothing the magnetic field signature, processing a temporal and signal strength correlation algorithm for analyzing the magnetic field signature for determining a proximity and size of the target object, processing a vehicle state definition algorithm whereby a state of the host vehicle in relation to the target object is determined, or processing a countermeasure state definition algorithm for determining whether a countermeasure is required and which countermeasure may be required.

[0046] In response to signals generated during the processing steps, a countermeasure is activated in response to signals indicating a target vehicle in or near the vehicle blind-spot.

[0047] While particular embodiments of the invention have been shown and described, numerous variations and alternate embodiments will occur to those skilled in the art. Accordingly, it is intended that the invention be limited only in terms of the appended claims.

Claims

[c1] 1 A warning system for a host vehicle comprising:
a first magneto-resistive sensor coupled to the host vehicle, said first magneto-resistive sensor sensing a first magnetic field variation in a first sensor area external to the host vehicle and generating a first sensor signal therefrom; and
a controller coupled to the host vehicle receiving said first sensor signal, said controller generating a signal for activating a vehicle system in response to said first sensor signal.

[c2] 2 The system of claim 1 further comprising a vehicle bus receiving various vehicle control signals and generating therefrom a vehicle bus signal, wherein said controller generates said signal for activating said vehicle system as a function of said vehicle bus signal.

[c3] 3 The system of claim 2, wherein said vehicle bus receives at least one of a vehicle type information signal, a vehicle speed signal, an RPM signal, a heading of host vehicle signal, a location of vehicle signal, a host vehicle directional signal, a steering wheel angle signal, or a brake status signal and generates said vehicle bus signal as a function of said at least one of said signals.

[c4] 4 The system of claim 1 further comprising a vehicle warning interface receiving said signal for activating said vehicle system from said controller, said vehicle warning interface activating said vehicle system in response to said signal for activating said vehicle system.

[c5] 5 The system of claim 4, wherein said vehicle system comprises at least one of a dashboard light, a light guide, an LED, a radio, a speaker, a pre-crash warning system, a heads-up display, or a passive restraint system.

[c6] 6 The system of claim 1 further comprising a second magneto-resistive sensor sensing a second magnetic field variation in a second sensor area external to the host vehicle and generating a second sensor signal therefrom.

[c7] 7 A system as recited in claim 1, wherein said sensor is coupled to at least one of an area near a rear of the vehicle, a trunk lid, a tailgate, a bumper, an area above tires of the vehicle, an area within vehicle side panels, or a rear portion of

a roof of the vehicle.

[c8] 8 The system of claim 1, wherein said controller further comprises at least one of a signal conditioning algorithm, a temporal and signal strength correlation algorithm, a vehicle state definition algorithm, or a countermeasure state definition algorithm for generating said signal for activating said vehicle system.

[c9] 9 The system of claim 8, wherein said temporal and signal strength correlations algorithms are used in conjunction with a threshold comparison to assess a probability of an accident.

[~~c10~~] 10 The system of claim 1, wherein said first sensor area coincides with at least a portion of a blind-spot of the host vehicle.

[~~c11~~] 11 A method for operating a blind-spot detection system for a host vehicle comprising:

sensing magnetic field changes caused by a target object in or near a vehicle blind-spot;

generating a magnetic field signature as a function of said magnetic field changes;

processing at least one algorithm as a function of said magnetic field signature; and

activating a countermeasure in response to signals indicating a target vehicle in or near said vehicle blind-spot as a function of said processing of said at least one algorithm.

[~~c12~~] 12 The method of claim 11 further comprising receiving a vehicle control signal; generating a vehicle bus signal from said vehicle control signal; and processing said at least one algorithm as a function of said vehicle bus signal.

[~~c13~~] 13 The method of claim 12, wherein said vehicle bus receives at least one of a vehicle type information signal, a vehicle speed signal, an RPM signal, a heading of host vehicle signal, a location of vehicle signal, a host vehicle directional signal, a steering wheel angle signal, or a brake status signal and generates said vehicle bus signal as a function of said at least one of said signals.

[~~c14~~] 14 The method of claim 11, wherein processing further comprises determining required countermeasures necessary to reduce a likelihood of an accident.

[~~c15~~] 15 The method of claim 11, wherein processing further comprises processing a magnetic signal conditioning algorithm for filtering and smoothing said magnetic field signature.

[~~c16~~] 16 The method of claim 11, wherein processing further comprises processing a temporal and signal strength correlation algorithm for analyzing said magnetic field signature for determining a proximity and size of said target object.

[~~c17~~] 17 The method of claim 11, wherein processing further comprises processing a vehicle state definition algorithm whereby a state of the host vehicle in relation to said target object is determined.

[~~c18~~] 18 The method of claim 11, wherein processing further comprises processing a countermeasure state definition algorithm for determining whether a countermeasure is required and which countermeasure may be required.

[~~c19~~] 19

A blind-spot detection system for a host vehicle comprising:

a first magneto-resistive sensor coupled to a first rear area of the host vehicle, said first magneto-resistive sensor sensing a first magnetic field variation in a first sensor area coinciding at least partially with a first blind-spot of the host vehicle, said first magneto-resistive sensor generating a first sensor signal therefrom;

a second magneto-resistive sensor coupled to a second rear area of the host vehicle, said second magneto-resistive sensor sensing a second magnetic field variation in a second sensor area coinciding at least partially with a second blind-spot of the host vehicle, said second magneto-resistive sensor generating a second sensor signal therefrom;

a vehicle bus receiving various vehicle control signals and generating therefrom a vehicle bus signal;

a vehicle warning interface receiving a signal for activating said vehicle system, said vehicle warning interface activating said vehicle system in response to said signal for activating said vehicle system; and

a controller coupled to the host vehicle receiving said first sensor signal, said second sensor signal, and said vehicle bus signal, said controller generating said signal for activating a vehicle system in response to said vehicle bus signal and at least one of said first sensor signal or said second sensor signal.

[~~c20~~] 20 The system of claim 19, wherein said vehicle system comprises at least one of a dashboard light, a light guide, an LED, a radio, a speaker, a pre-crash warning system, or a passive restraint system.

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~~Blind-Spot Warning System For~~ An ~~Automotive Vehicle~~

Abstract of Disclosure

A host vehicle system includes a blind-spot warning system providing an indication to the host vehicle a target vehicle entering a blind-spot. The system includes a vehicle bus receiving various vehicle control signals, magneto-resistive sensors receiving proximity information as a function of magnetic field variations, a smart algorithm controller analyzing bus signals and sensor signals, and various vehicle collision systems such as passive restraints, optical light guides, and audible warnings operating in response to a threat from a target vehicle.